Enthalpy change calculations

QUESTIONS: Carry out the following enthalpy change calculations

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1) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ $\Delta rH = -889$ kJ mol^{-1}
Calculate the energy released when 128 g of methane is burnt.
M (CH4) = 16.0 g mol–1.

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2) Magnesium burns in oxygen to produce magnesium oxide. The equation for the chemical reaction is be represented by:
$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$ $\Delta_r H = -1200$ kJ mol^{-1}
Calculate how much energy is released when 15.4 g of oxygen gas reacts.
Calculate the mass of magnesium that must react to release 98.2 kJ of energy.

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3) The overall reaction occurring in many disposable hand warmers can be represented by:
$4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ $\Delta_r H = -1652$ kJ mol^{-1}
(i) Calculate the energy released when 1.00 mol Fe_2O_3 is produced.
(ii) Calculate the mass of Fe that would be required to release 185 kJ of energy. *M*(Fe) = 55.9 g mol^{-1}.

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4) Hydrogen and methane can be used as fuels.
$2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$ $\Delta_r H = -570$ kJ mol^{-1}
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$ $\Delta_r H = -890$ kJ mol^{-1}
Determine which of the fuels, hydrogen or methane, provides the most energy per gram of fuel burned. Justify your answer with calculations.
M(H_2) = 2.00g mol^{-1} *M*(CH_4) = 16.0 g mol^{-1}

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5) When a 12.2 g sample of ammonia is burned, 275 kJ of energy is released. Calculate the energy released for the reaction below, when four moles of ammonia are burned. $4NH_3(g) + 3O_2(g) \rightarrow 2N_2(g) + 6H_2O(\ell)$ $M(NH_3)$ = 17.0 g mol^{-1}	**6)** The equation for the reaction between calcium oxide, CaO, and water can be represented as $CaO(s) + H_2O(\ell) \rightarrow Ca(OH)_2(aq)$ $\Delta H = -82.0$ kJ mol^{-1} Calculate the mass of calcium oxide required to release 287 kJ of energy. $M(CaO)$ = 56.0 g mol^{-1}
7) When an 18.4 g sample of ethanol is burned, 546 kJ of energy is released. Determine the enthalpy change, $\Delta_r H$, for the reaction when one mole of ethanol is burned. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$ $M(C_2H_5OH)$ = 46.0 g mol^{-1}	**8)** 29.6 g of sodium hydroxide was dissolved in water and excess hydrochloric acid was added. Using the temperature increase and the heat capacity of water, it was calculated that 43.5 kJ of heat was released. Determine the enthalpy change, $\Delta_r H$, for the following reaction: $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$ What mass of sodium hydroxide is required to produce 150 kJ of energy?

9) The principle of a fireworks-type explosion can be demonstrated by igniting a sucrose jellybaby with sodium chlorate, $NaClO_3$. The equation for the explosion reaction is: $2NaClO_3(s) + C_{12}H_{22}O_{11}(s) \longrightarrow 2NaCl(s) + 9C(s) + 3CO_2(g) + 11H_2O(g)$ $\Delta_r H° = -2192$ kJ mol^{-1} Calculate the quantity of heat released when one jelly-baby containing 4.56 g of sucrose ($C_{12}H_{22}O_{11}$) is exploded. The heat released by the explosion can be used to vaporise strontium chloride to give the fireworks colour. The heat required to convert $SrCl_2$ from the solid to the gas state is 343 kJ mol$_{-1}$. Use your answer to (i) above to calculate the mass of solid $SrCl_2$ that can be vaporised by exploding one jelly baby containing 4.5 g of sucrose.	**10)** Octane is a key component in petrol, and burns according to the following equation: $C_8H_{18}(l) + 12\frac{1}{2} O_2(g) \rightarrow 8 CO_2(g) + 9 H_2O(l)$ $\Delta_r H = -5500$ kJ mol^{-1} 1.00 litre of octane contains 6.12 moles of the fuel. Calculate the energy released when 1 litre of the fuel is burnt. Using hydrogen gas (H_2) as a fuel for cars, rather than octane, is often viewed as better for the environment. Calculate the mass of H_2 required to produce the same amount of energy as 1.00 litre of octane, as calculated in part (b) above. State your answer to 3 significant figures. $H_2(g) + \frac{1}{2} O_2(g) \rightarrow H_2O(g)$ $\Delta_r H = -286$ kJ mol^{-1}